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Observations of the Moon made at the Radcliffe Observatory, Oxford, during the year 1890; *and a Comparison of the Results with the Tabular Places from Hansen's Lunar Tables.* By E. J. Stone, M.A., F.R.S., Radcliffe Observer.

The present paper contains the observations of the right ascensions and north polar distances of the Moon, made at the Radcliffe Observatory during the year 1890. These results are here compared with those deduced from Hansen's Lunar Tables on two suppositions :—

(1) That the mean times, found in the usual way from the sidereal times at mean noon, given in the *Nautical Almanac*, were *not* changed in 1864 by the adoption of a different unit of time.

(2) That these mean times *were* changed in 1864 by the adoption of a different unit of time to fix the positions of the clock stars relatively to the Sun, in accordance with the views which I have explained in papers communicated to the Society.

In the Appendix to the *Monthly Notices*, vol. l., will be found the results of a comparison between the Greenwich Lunar Observations, 1847–1861, and Hansen's Tables, of greater accuracy than had before been available for use; and these results have been utilised to form the mean results given in Table III.

An examination of the residual errors shows that the motion of the Moon was closely represented by Hansen's Tables during the period 1847–1863, although periodical errors of no inconsiderable amount, due either to defects of theory or to imperfections in the practical methods of comparing the theoretical and observational results, are shown to exist.

The mean annual error in longitude of Hansen's Tables from 1847 to 1863 is, however, only $-1''\cdot85$, and no law of regular increase is apparent; but Table III. shows that when the time, *t*, is found as at present, the mean annual error has increased since 1863 at an average rate of $0''\cdot72$ per annum, and that the error now amounts to $+18''$. The mean annual error of Hansen's Tables from 1864 to 1890 taken out with the *corrected* argument is $-1''\cdot44$, which differs but very slightly from the mean error between 1847 and 1863.

For facilities for an accurate comparison between Hansen's Lunar Tables and Observations, I am again indebted to the places published in the *Connaissance des Temps.*

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TABLE I.

Radcliffe Observations of the Moon, 1890.

R.A.'s and N.P.D.'s of the Centre of the Moon, 1890; *compared with Hansen's Tabular Places,* **Uncorrected** *and* **Corrected** *for the change in the Unit of Mean Time introduced in the year* 1648.

Day, 1890.	Correction to be subtracted from M.T. for change of Sidereal Time at Mean Noon since 1864.	Observer.	Limb observed in N.P.D.	Observed R.A.	R.A. from Hansen's Tables for Uncorrected Mean Times.	Hansen *minus* Observed. **Uncorrected.**	Correction due to the Change in the Unit of Mean Time.	Hansen *minus* Observed. **Corrected.**	Limb observed in R.A.	Observed N.P.D.	N.P.D. from Hansen's Tables for Uncorrected Mean Times.	Hansen *minus* Observed. **Uncorrected.**	Correction due to the Change in the Unit of Mean Time.	Hansen *minus* Observed. **Corrected.**
	s			h m s	s	s	s	s		° ′ ″	″	″	″	″
Jan. 8	38·60	R.	II.	9 34 16·09	16·95	+0·86	−1·30	−0·44	S.	71 29 8·77	13·35	+4·58	−5·00	−0·42
29	38·68	F. B.	I.	4 2 52·33	53·42	+1·09	−1·32	−0·23	S.	71 57 20·43	18·55	−1·88	+5·30	+3·42
Feb. 3	38·70	F. B.	I.	8 25 54·85	55·89	+1·04	−1·36	−0·32	N.	68 1 33·21	34·95	+1·74	−3·09	−1·35
5	38·71	R.	II.	10 7 45·32	46·25	+0·93	−1·29	−0·36	S.	73 54 44·26	49·51	+5·25	−5·94	−0·69
9	38·72	R.	II.	13 19 31·07	31·92	+0·85	−1·26	−0·41	S.	93 7 45·60	53·89	+8·29	−8·28	+0·01
12	38·74	R.	II.	15 56 23·70	24·74	+1·04	−1·49	−0·45	S.	107 43 30·80	34·75	+3·95	−6·21	−2·26
27	38·80	W.	I.	5 27 22·82	23·82	+1·00	−1·38	−0·38	S.	67 28 23·70	20·99	−2·71	+2·78	+0·07
Mar. 3	38·81	W.	I.	8 59 17·54	18·63	+1·09	−1·34	−0·25	N.	69 26 29·47	32·16	+2·69	−4·20	−1·51
5	38·82	R.	I.	10 39 37·28	38·23	+0·95	−1·28	−0·33	N.	76 33 41·09	46·58	+5·49	−6·80	−1·31
8	38·83	R.	II.	13 4 9·58	10·49	+0·91	−1·27	−0·36	S.	91 37 20·64	28·09	+7·45	−8·46	−1·01
29	38·92	F. B.	I.	7 46 43·70	44·85	+1·15	−1·39	−0·24	N.	66 29 7·35	8·58	+1·23	−1·94	−0·71
31	38·92	R.	I.	9 30 27·77	28·75	+0·98	−1·32	−0·34	N.	71 4 40·36	44·60	+4·24	−5·16	−0·92
Apr. 1	38·93	R.	I.	10 20 20·80	21·68	+0·88	−1·29	−0·41	N.	74 46 58·88	63·41	+4·53	−6·46	−1·93
2	38·93	F. B.	I.	11 9 10·19	11·12	+0·93	−1·27	−0·34	N.	79 13 51·56	57·13	+5·57	−7·50	−1·93

Day, 1890.	Correction to be subtracted from M.T. for change of Sidereal Time at Mean Noon since 1864.	Observer.	Limb observed in R.A.	Observed R.A.	R.A. from Hansen's Tables for Uncorrected Mean Times.	Hansen *minus* Observed. **Uncorrected.**	Correction due to the Change in the Unit of Mean Time.	Hansen *minus* Observed. **Corrected.**	Limb observed in N.P.D.	Observed N.P.D.	N.P.D. from Hansen's Tables for Uncorrected Mean Times.	Hansen *minus* Observed. **Uncorrected.**	Correction due to the Change in the Unit of Mean Time.	Hansen *minus* Observed. **Corrected.**
	s			h m s	s	s	s	s		° ′ ″	″	″	″	″
Apr. 3	38·94	W.	I.	11 57 27·03	28·18	+1·15	−1·27	−0·12	N.	84 14 48·81	56·43	+7·62	−8·24	−0·62
29	39·04	R.	I.	10 48 42·24	42·99	+0·75	−1·27	−0·52	N.	77 5 33·65	39·50	+5·85	−7·10	−1·25
30	39·04	F. B.	I.	11 36 44·61	45·63	+1·02	−1·26	−0·24	N.	81 53 12·74	20·37	+7·63	−7·99	−0·36
May 1	39·05	W.	I.	12 24 47·32	48·30	+0·98	−1·27	−0·29	N.	87 9 29·05	34·32	+5·27	−8·60	−3·33
2	39·05	R.	I.	13 13 44·07	44·91	+0·84	−1·31	−0·47	N.	92 42 18·69	24·97	+6·28	−8·85	−2.57
11	39·09	R.	II.	22 13 13·09	14·50	+1·41	−1·50	−0·09	N.	106 5 18·34	10·46	−7·88	+7·33	−0·55
26	39·15	F. B.	I.	10 28 43·98	45·01	+1·03	−1·27	−0·24	N.	75 8 58·08	61·87	+3·79	−6·60	−2·81
31	39·17	F. B.	I.	14 32 18·03	19·20	+1·17	−1·41	−0·24	N.	101 4 29·58	37·57	+7·99	−8·41	−0·42
June 6	39·19	W.	II.	20 52 54·41	56·23	+1·82	−1·67	+0·15	N.	111 29 19·07	14·47	−4·60	+5·02	+0·42
26	39·27	W.	I.	13 18 14·32	15·12	+0·80	−1·27	−0·47	N.	93 6 58·65	64·52	+5·87	−8·65	−2·78
27	39·28	R.	I.	14 7 35·84	36·80	+0·96	−1·34	−0·38	N.	98 32 18·93	25·39	+6·46	−8·50	−2·04
July 3	39·30	F. B.	II.	20 23 30·23	32·05	+1·82	−1·77	+0·05	N.	112 46 21·55	17·77	−3·78	+4·05	+0·27
28	39·40	R.	I.	17 31 33·40	34·65	+1·25	−1·72	−0·47	N.	113 19 7·04	10·51	+3·47	−3·32	+0·15
Aug. 1	39·42	R.	II.	22 0 54·60	56·08	+1·48	−1·65	−0·17	N.	107 3 8·74	0·93	−7·81	+7·70	−0·11
5	39·43	R.	II.	1 44 25·32	26·67	+1·35	−1·37	−0·02	N.	83 45 19·64	11·53	−8·11	+9·01	+0·90
7	39·44	W.	II.	3 27 21·00	22·41	+1·41	−1·38	+0·03	N.	73 43 57·18	51·41	−5·77	+6·72	+0.95
23	39·50	R.	I.	16 4 50·19	51·32	+1·13	−1·50	−0·37	N.	109 12 11·18	16·04	+4·86	−6·05	−1·19
29	39·53	W.	I. & II.	22 30 12·06	13·72	+1·66	−1·62	+0·04	S.	104 34 34·53	26·19	−8·34	+8·63	+0·29

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Day, 1890.	Correction to be subtracted from M.T. for change of Sidereal Time at Mean Noon since 1864.	Observer.	Limb observed in R.A.	Observed R.A.	R.A. from Hansen's Tables for Uncorrected Mean Times.	Hansen *minus* Observed. **Uncorrected.**	Correction due to the Change in the Unit of Mean Time.	Hansen *minus* Observed. **Corrected.**	Limb observed in N.P.D.	Observed N.P.D.	N.P.D. from Hansen's Tables for Uncorrected Mean Times.	Hansen *minus* Observed. **Uncorrected.**	Correction due to the Change in the Unit of Mean Time.	Hansen *minus* Observed. **Corrected.**
	s			h m s	s	s	s	s		° ′ ″	″	″	″	″
Sept. 4	39·55	F. B.	II.	3 59 52·75	54·25	+1·50	−1·43	+0·07	N.	71 1 44·64	40·07	−4·57	+5·91	+1·34
22	39·62	R.	I.	18 47 44·62	46·06	+1·44	−1·71	−0·27	S.	114 57 4·31	3·69	−0·62	+0·03	−0·59
25	39·64	F. B.	I.	22 0 6·97	8·59	+1·62	−1·62	0·00	S.	107 11 65·54	59·99	−5·55	+7·72	+2·17
27	39·64	F. B.	I.	23 57 11·30	12·83	+1·53	−1·49	+0·04	S.	95 42 25·05	17·76	−7·29	+10·09	+2·80
30	39·66	R.	II.	2 40 47·14	48·27	+1·13	−1·44	−0·31	N.	77 26 9·26	1·21	−8·05	+8·46	+0·41
Oct. 1	39·66	F. B.	II.	3 35 17·80	19·22	+1·42	−1·46	−0·04	N.	72 35 64·19	58·55	−5·64	+6·90	+1·26
21	39·74	R.	I.	20 35 29·12	30·51	+1·39	−1·66	−0·27	S.	112 43 9·27	4·10	−5·17	+4·54	−0·63
28	39·77	W.	II.	3 8 23·42	25·01	+1·59	−1·46	+0·13	N.	74 44 59·34	52·18	−7·16	+7·87	+0·71
Nov. 2	39·79	R.	II.	7 49 25·01	25·99	+0·98	−1·45	−0·47	S.	65 32 43·25	43·38	+0·13	−2·27	−2·14
21	39·86	R.	I.	0 7 28·21	29·64	+1·43	−1·41	+0·02	S.	94 43 49·91	41·14	−8·77	+9·80	+1·03
24	39·88	W.	I.	2 44 32·89	34·13	+1·24	−1·43	−0·19	S.	76 59 60·35	52·69	−7·66	+8·42	+0·76
25	39·88	W.	I.	3 38 44·83	46·13	+1·30	−1·47	−0·17	S.	72 11 20·62	15·59	−5·03	+6·96	+1·93
26	39·88	R.	II.	4 34 34·79	35·82	+1·03	−1·51	−0·48	S.&N.	68 24 47·36	42·74	−4·62	+5·10	+0·48
Dec. 25	40·00	W.	I. & II.	6 5 48·64	50·09	+1·45	−1·53	−0·08	N.	65 2 56·44	54·04	−2·40	+1·62	−0·78
						s		s				″		′
Mean of Errors, without regard to sign ...					...	**1·191**	...	**0·256**		...	...	**5·297**	...	**1·208**
Mean Errors for the Year					...	**+1·191**	...	**−0·233**						

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Table II.

Radcliffe Observations of the Moon, 1890.

Errors of the Moon's Tabular Place in Longitude and Ecliptic Polar Distance, **Uncorrected** *and* **Corrected** *for the Change in the Unit of Mean Time introduced in the year* 1864.

Day, 1890.	Observer.	Limb observed in R.A.	Limb observed in N.P.D.	Errors of Longitude (Hansen *minus* Observed).		Errors of E.N.P.D. (Hansen *minus* Observed).	
				Uncorrected.	**Corrected.**	**Uncorrected.**	**Corrected.**
Jan. 8	R.	II.	S.	+13″·09	−6″·08	+0″·41	+1″·61
Jan. 29	F.B.	I.	S.	+15·65	−3·89	+1·16	+2·72
Feb. 3	F.B.	I.	N.	+14·49	−4·65	−1·74	−0·26
5	R.	II.	S.	+14·44	−5·11	+0·19	+1·18
9	R.	II.	S.	+14·98	−5·71	+2·90	+2·31
12	R.	II.	S.	+15·37	−6·77	+0·82	−0·89
Feb. 27	W.	I.	S.	+13·98	−5·26	−1·93	−0·22
Mar. 3	W.	I.	N.	+15·49	−3·80	−1·70	−0·47
5	R.	I.	N.	+14·95	−4·97	−0·12	+0·60
8	R.	II.	S.	+15·49	−5·38	+1·64	+1·14
Mar. 29	F.B.	I.	N.	+15·80	−3·38	−1·61	−0·11
31	R.	I.	N.	+14·57	−4·88	−0·38	+0·65
Apr. 1	R.	I.	N.	+13·56	−6·25	−0·39	+0·35
2	F.B.	I.	N.	+14·85	−5·39	−0·22	+0·18
3	W.	I.	N.	+18·85	−1·90	+0·13	+0·15
Apr. 29	R.	I.	N.	+12·41	−7·53	+1·24	+1·73
30	F.B.	I.	N.	+17·01	−3·43	+0·98	+1·09
May 1	W.	I.	N.	+15·69	−5·35	−0·98	−1·34
2	R.	I.	N.	+14·09	−7·52	+1·14	+0·29
11	R.	II.	N.	+21·90	−1·02	−0·10	−0·98
May 26	F.B.	I.	N.	+15·33	−4·28	−1 97	−1·33
31	F.B.	I.	N.	+18·91	−3·49	+2·18	+0·71
June 6	W.	II.	N.	+25·74	+1·90	+2·49	+0·97
June 26	W.	I.	N.	+13·37	−7·60	+0·92	+0·08
27	R.	I.	N.	+15·64	−6·02	+1·25	−0·01
July 3	F.B.	II.	N.	+25·44	+0·61	+2·22	+0·42

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Day, 1890.	Observer.	Limb observed in R.A.	Limb observed in N.P.D.	Errors of Longitude Hansen (*minus* Observed). **Uncorrected.**	Errors of Longitude Hansen (*minus* Observed). **Corrected.**	Errors of E.N.P.D. Hansen (*minus* Observed). **Uncorrected.**	Errors of E.N.P.D. Hansen (*minus* Observed). **Corrected.**
July 28	R.	I.	N.	+17″·36	−6″·46	+2″·62	+0″·47
Aug. 1	R.	II.	N.	+22·70	−2·26	+0·03	−0·95
5	R.	II.	N.	+21·75	−0·60	−0·34	+0·73
7	W.	II.	N.	+21·13	+0·18	−0·61	+1·03
Aug. 23	R.	I.	N.	+16·65	−5·37	+1·67	−0·15
29	W.	I. & II.	S.	+25·57	+0·43	+1·15	+0·48
Sept. 4	F.B.	II.	N.	+21·78	+0·71	−0·23	+1·51
Sept. 22	R.	I.	S.	+19·58	−3·61	+1·01	−0·89
25	F.B.	I.	S.	+23·78	−0·75	+2·83	+2·03
27	F.B.	I.	S.	+23·95	−0·58	+2·45	+2·81
30	R.	II.	N.	+18·25	−4·45	−2·60	−1·00
Oct. 1	F.B.	II.	N.	+21·09	−0·85	−0·72	+1·09
Oct. 21	R.	I.	S.	+19·98	−3·79	−0·17	−1·55
28	W.	II.	N.	+24·10	+1·62	−0·63	+1·20
Nov. 2	R.	II.	S.	+13·41	−6·71	−2·33	−0·92
Nov. 21	R.	I.	S.	+23·27	−0·14	+0·48	+1·07
24	W.	I.	S.	+19·61	−2·88	−1·85	−0·11
25	W.	I.	S.	+19·22	−2·81	−0·59	+1·31
26	R.	II.	S. & N.	+14·91	−6·70	−2·47	−0·50
Dec. 25	W.	I. & II.	N.	+19·70	−1·10	−2·57	−0·77
Mean of Errors, without regard to sign	...	...	...	**18″·019**	**3″·786**	**1″·264**	**0″·921**
Mean Errors for Year		...	...	**+18″·019**	**−3″·549**	...	...

Observers: W., Mr. W. Wickham; R., Mr. W. H. Robinson; F.B., Mr. F. A. Bellamy.

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TABLE III.

Mean Excess over Observation of the Moon's Tabular Place in Longitude for the years 1847 *to* 1890, *as Computed from Hansen's Tables.*

Uncorrected *and* **Corrected** *for the change in the Unit of Mean Time introduced in the year* 1864.

Year.	Errors of Longitude (Hansen *minus* Observed).	
	Uncorrected.	**Corrected.**
	″	″
1847	+ 0·51	+0·51
1848	− 0·53	−0·53
1849	− 1·08	−1·08
1850	− 0·97	−0·97
1851	− 1·93	−1·93
1852	− 1·57	−1·57
1853	− 2·18	−2·18
1854	− 2·34	−2·34
1855	− 1·40	−1·40
1856	− 1·51	−1·51
1857	− 2·41	−2·41
1858	− 2·61	−2·61
1859	− 2·49	−2·49
1860	− 3·62	−3·62
1861	− 2·95	−2·95
1862	− 2·83	−2·83
1863	− 1·61	−1·61
1864	+ 0·12	−0·81
1865	+ 1·27	−0·22
1866	+ 2·14	−0·22
1867	+ 3·48	+0·36
1868	+ 4·12	+0·28
1869	+ 4·28	−0·35
1870	+ 4·83	−0·66
1871	+ 6·96	+0·44
1872	+ 7·31	+0·10
1873	+ 8·24	+0·20
1874	+ 9·29	+0·56
1875	+ 9·87	+0·36
1876	+ 9·80	−0·50
1877	+ 9·23	−1·90
1878	+ 8·22	−3·60
1879	+ 9·63	−3·12
1880	+10·89	−2·77
1881	+10·51	−4·06
1882	+12·68	−2·51
1883	+14·71	−1·50
1884	+14·65	−1·91
1885	+15·20	−1·82
1886	+15·34	−2·53
1887	+15·70	−3·25
1888	+17·68	−2·46
1889	+17·37	−3·51
1890	+18·02	−3·55

1847 to 1879: Greenwich observations. 1880 to 1882: Mean of Greenwich and Radcliffe. 1883 to 1890: Radcliffe observations.

Radcliffe Observatory, Oxford:
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Preliminary Note on the Change of Personal Equation with Stellar Magnitude in Transits observed with the Transit Circle at the Royal Observatory, Greenwich. By W. H. M. Christie, M.A., F.R.S., Astronomer Royal.

The question of the determination of the variation of personal equation with the magnitude of the star observed has been lately brought prominently forward by Professor Auwers in connection with the Greenwich observations of *Victoria* and *Sappho* and comparison stars in 1889, now being discussed by him. I had hoped to have used the Personal Equation Machine for this investigation, this being one of the objects for which it was originally intended, but as special photometric arrangements would have to be devised, it was judged best, in order to avoid delay, to determine the change of personal equation in observations of stars with the transit circle, when screens of fine wire gauze were placed in front of the object-glass to obscure the stars' light. The screens used were marked *a*, *b*, *e*, *f*, and *g*, the first three being made of fine brass wire, and the last two of coarser iron wire. The size of the meshes, which are approximately square, and the thickness of the wires, were measured with a micrometer microscope for each of these screens, and the results are given in the following table.

	Screen *a*.	*b*.	*e*.	*f*.	*g*.
	mm.	mm.	mm.	mm.	mm.
Side of squares of mesh ...	0·45	0·52	0·39	1·08	1·21
Thickness of wire ...	0·12	0·13	0·13	0·34	0·30

As the star entered the field of the telescope, the object-glass was covered successively by one or other of these screens, or by two screens superposed, the observer then making estimations of the apparent magnitude of the stars, whose light was thus diminished. The accuracy of these estimations was tested by the comparison of the magnitude given in the Greenwich Ten-Year Catalogue, or in the British Association Catalogue, with similar estimations of magnitude, either (1) with the object-glass unscreened, when the estimated magnitude should agree with the tabular, or (2) when card diaphragms, with circular apertures of $5\frac{1}{8}$ and $3\frac{1}{4}$ inches diameter respectively, were placed over the object-glass, so that the estimated magnitudes should differ by 1·0 and 2·0 magnitudes respectively from the tabular. The mean results of these estimations for each observer, and for each screen, diaphragm, or pair of screens, are given in Table I. It will be seen from the estimations with full aperture, and with diaphragms *c* and *d*, that all the observers agree in estimating the magnitude as numerically too large, and that